

Laser Safety at the Idaho National Laboratory

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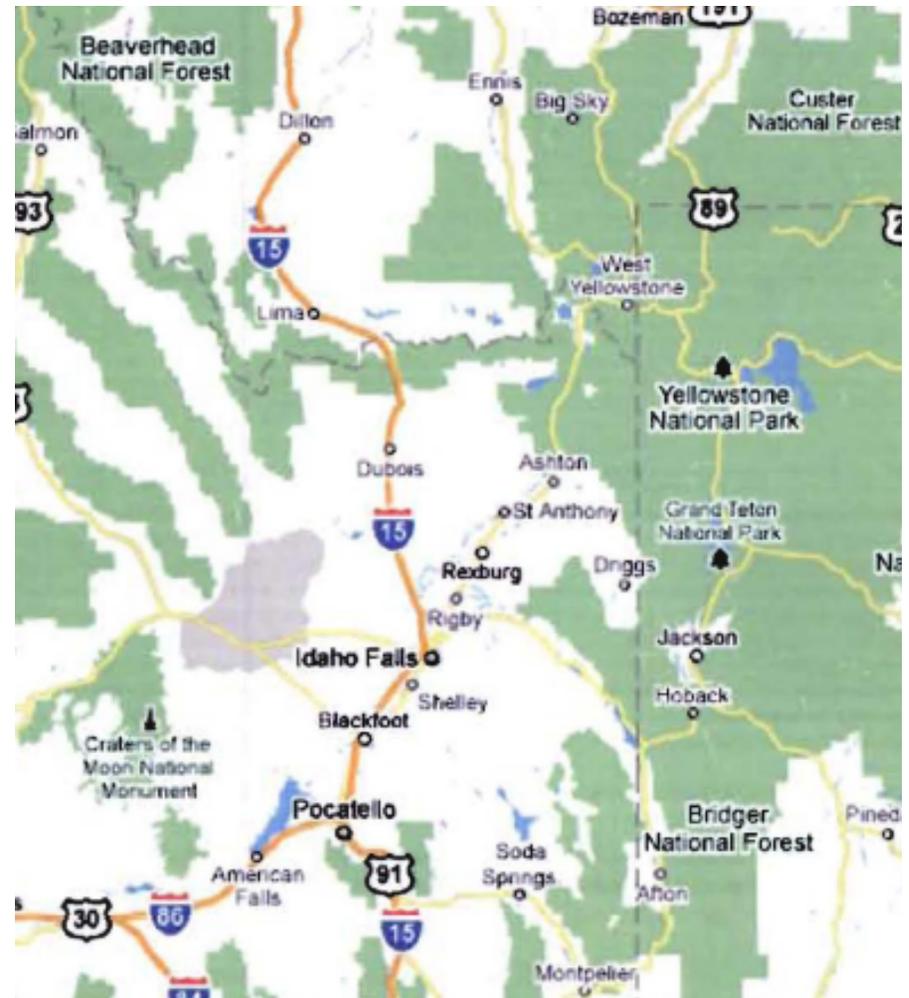
INL History



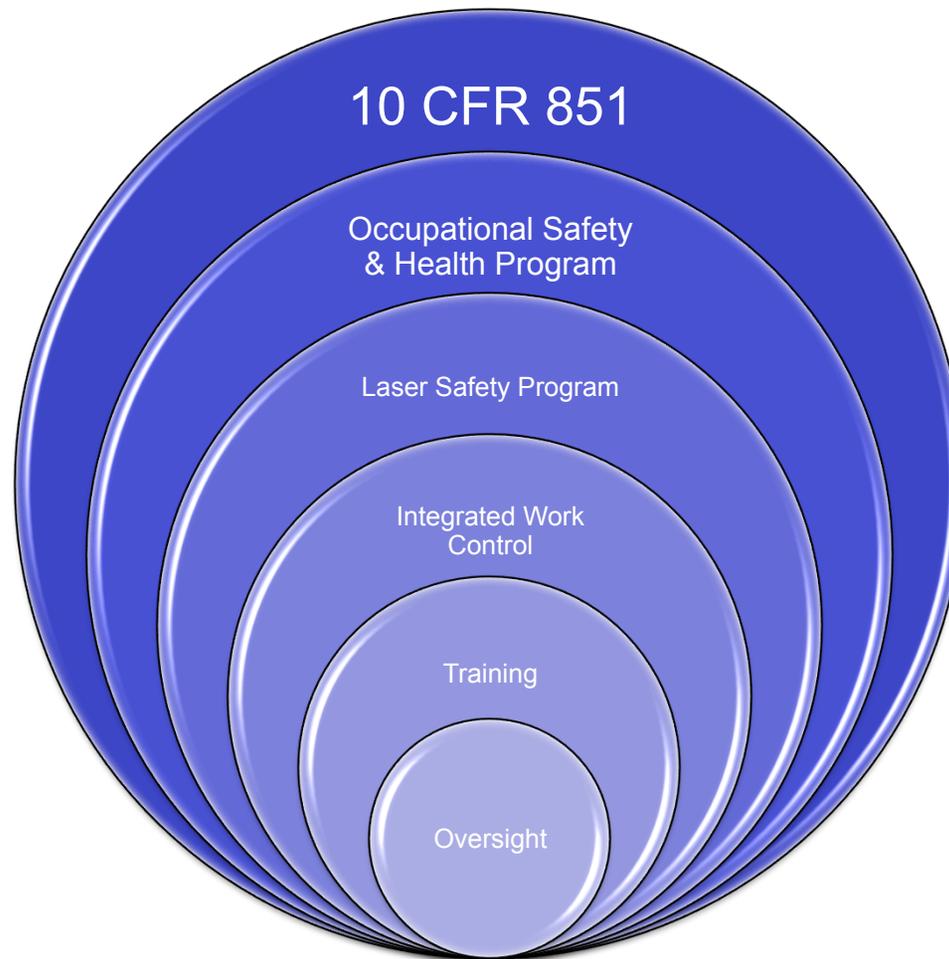
- In operation since 1949
- 890 square mile desert site in Eastern Idaho
- Over 6000 employees
- EBR-1 National Historic Landmark
 - Supplied first usable amounts of electricity generated by nuclear power to Arco, Idaho

Surrounding Interests

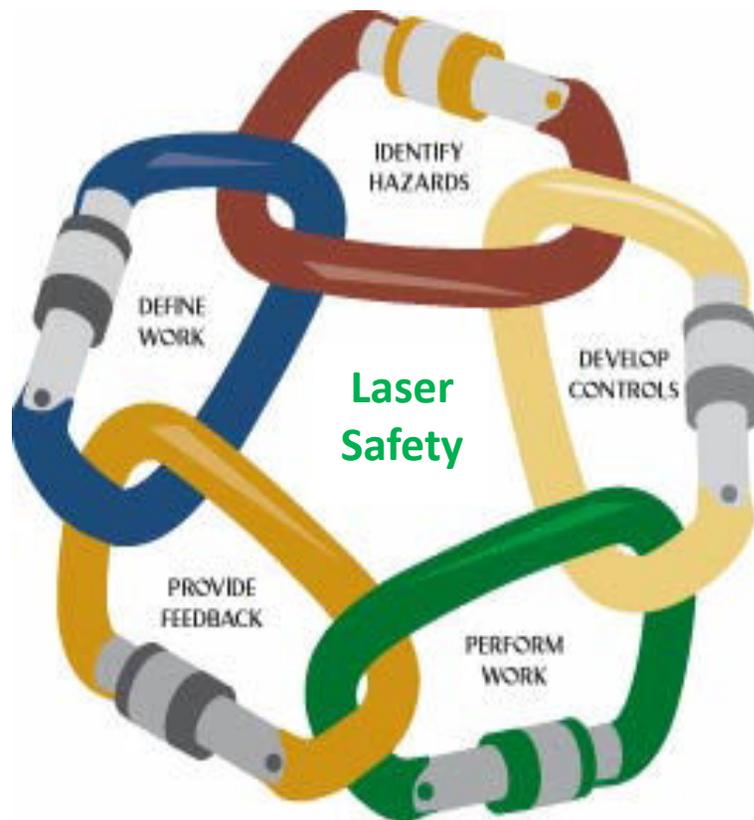
- National Parks: Yellowstone-138 mi E; Grand Teton-121 mi E; Craters of the Moon-90 mi W
- Mines: Spencer Opal Mines-68 mi N
- Museums: Teton Flood Museum-30 mi N; Museum of Idaho, Idaho Falls
- Universities: ISU-51 mi S; BYU Idaho-30 mi N
- Resorts: Lava Hot Springs-84 mi S; Sun Valley-155 mi NW
- Hot Springs: Heise, Lava, Stanley, Carey, Lidy, Barney. . .
- Skiing: Kelly Canyon, Pebble Creek
- Sand Dunes: St. Anthony
- Reservoirs: Palisades, Mackay, American Falls, Island Park, Blackfoot. . .
- Fishing, hunting, boating



Laser Safety Hierarchy of Controls



Integrated Safety Management System



- 5 Core Functions
 - S·I·M·P·LE
- Integrated Work Control
 - Operations
 - R&D
 - Maintenance
 - Construction/Subs/Vendors
 - Service Orgs
- LWP-14608, Laser Safety

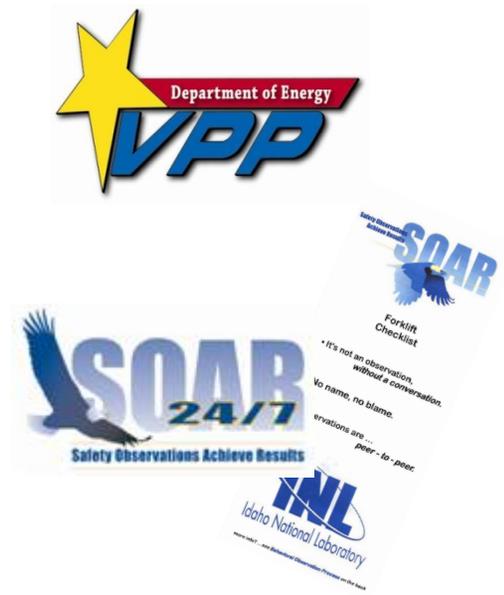
Integrated Safety Management System

- 8 Guiding Principles
- Line Management
- Worker Involvement
- Oversight



General Safety Programs

- VPP
- ISO 14001
- SOAR
- EST
- HPI



Laser Safety Program

- Required by 10 CFR 851, *Worker Safety and Health Program*
- All groups/organizations must incorporate applicable elements of LWP-14608, *Laser Safety Program*, into their performing documents.
- Captures elements from
 - ANSI Z136 series
 - NFPA 115 (laser safety)
 - OSHA 29 CFR 1926.54 (non-ionizing radiation)
 - IEC 60825-2 (fiber optic installation and maintenance)
 - ANSI Z535 series (signs and labels)
 - Best management practices
- All Class 3B/4 lasers must be captured on an inventory.

Integrated Work Control Process

- Operations and R&D
 - LWP-21220, *Work Management*
 - Lab Instructions (LI)
- Maintenance
 - LWP-21220, *Work Management* & LWP-6200, *Maintenance Integrated Work Control Process*
 - Preventive/corrective maintenance – planned work orders
 - Minor maintenance – skill of the craft
- Construction/Subcontractors/On-site Vendors
 - RD-2000, *Work Coordination and Hazard Control*
 - Contracts
 - Specifications/drawings
 - JSAs

Integrated Work Control Process

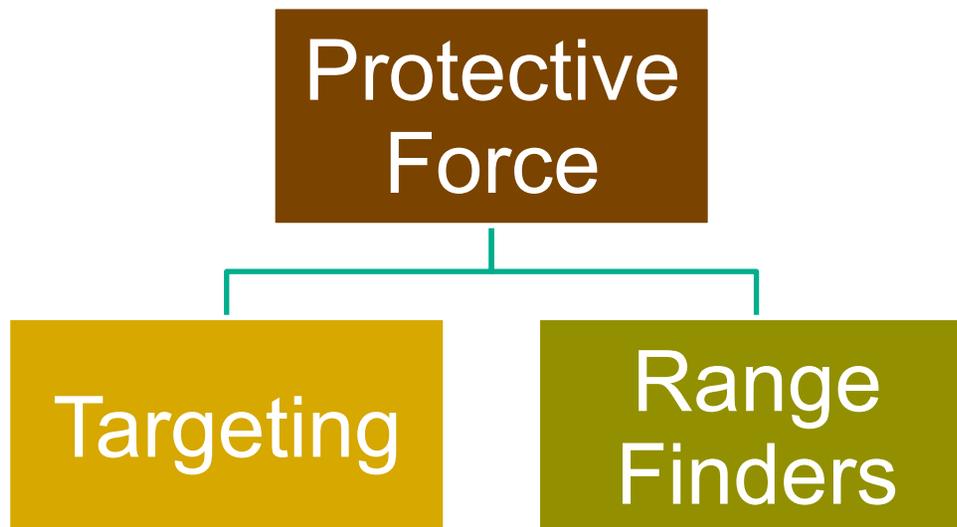
- Service Organizations
 - IH, IS, QA, ENV, RadCon, WGS
 - LRD-14005, *Activity Level Hazard Identification, Analysis and Control*
 - Follow those implemented by operations, R&D, construction, subcontract
 - LIs for organization-specific work
- LSO assigned to each facility

Laser Safety - Training

- Class 1M, 2, 2M, 3A, 3R
 - Site wide ES&H Awareness
 - Equipment-specific: operations, maintenance, R&D
 - Except consumer products (CD players, printers, pointers, etc.)
- Class 3B, 4
 - Online
 - Qualification checklist for manufacturing area
 - Alignment training for manufacturing areas
- LSO
 - Online (same as Class 3B/4)
 - Off-site LSO course, on-site written exam
- Supervisor training
- Auditors

Laser Applications - ProForce

The Multiple Integrated Laser Engagement System (MILES) gear is used for training purposes, using lasers and blank cartridges to simulate actual battle. Officers carry small laser receivers scattered over their bodies, which detect when the officer has been shined by a firearm's laser. Each laser transmitter is set to mimic the effective range of the weapon on which it is used. When a person is "hit," a medic can use the digital readout to determine which first aid method to practice.



- Equipment-specific training
- Laboratory Instructions
- Eyewear
- Area access controlled

Laser Applications – R&D

Laser-Based Materials Characterization

Description: Thermal waves are generated and detected using a Class 4 mode-locked Ti:Sapphire laser shown in the background.

- ❖ *The laser control area is defined by the table top and an imaginary plane 10" above the table.*
- ❖ *Lateral confinement is supplied by beam dumps and opaque guards placed at the side of the table.*
- ❖ *Limited keycard access to lab.*
- ❖ *Visible indicator light outside lab.*

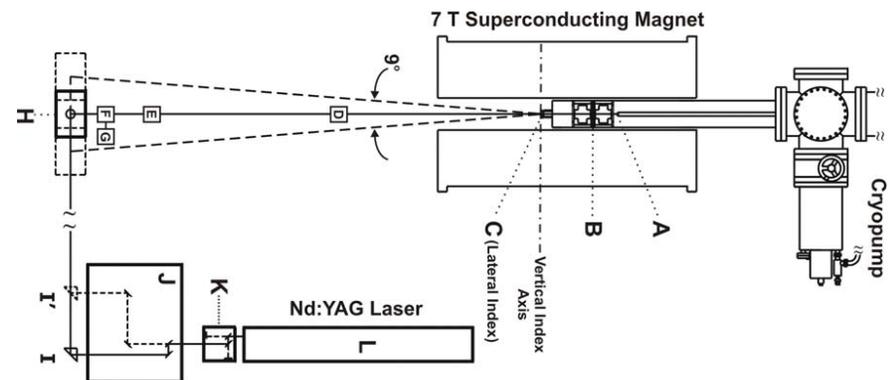


Laser Applications – R&D

Laser-Based Optical and Chemical Imager Research (LOCI)

Description: An in-house developed instrument using a Class 4 Nd:YAG laser that incorporates optical detection (surface laser-induced fluorescence (LIF), Raman, laser-induced breakdown spectroscopy (LIBS)) with a Fourier transform ion cyclotron resonance mass spectrometer (FTMS) for analysis of samples within and external to the INL.

- ❖ *Doors are locked.*
- ❖ *Limited keycard access.*
- ❖ *Output power limitations dictated by experiment.*
- ❖ *Color-coded barriers.*
- ❖ *Visible indicator light outside lab.*



Laser Applications – R&D

Matched Index of Refraction System (MIR)

Description: Obtains high quality detailed velocity and turbulence measurements for basic and applied research in liquid and two-phase particulate flows through complex configurations where measurements would normally be impractical or impossible. Such data may be employed to assess/validate Computational Fluid Dynamics (CFD) codes, to determine flow modification by a given component and to assist in determining potential erosion in complex passages.

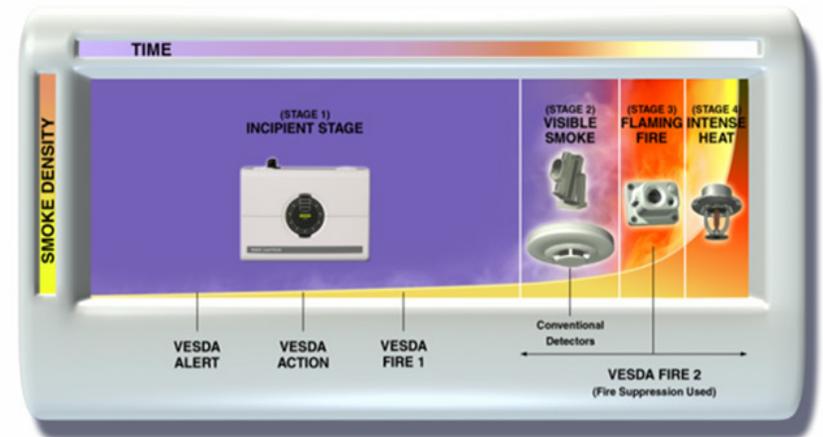
- ❖ *Main doors are locked/interlocked.*
- ❖ *Limited keycard access.*
- ❖ *Visible indicator light outside lab.*



Laser Applications – Life Safety Systems

High-Sensitivity Smoke Detection Systems

- AnaLASER II, Class 3B Embedded
 - The AnaLASER II Detector’s laser particle counter detects particles of combustion at levels of obscuration as low as 0.00015%/ft.
 - The air sampling pipe network is a system of pipes extended into the protected area with strategically placed sampling holes.
 - Ceiling mounted.
- Xtralis VESDA, Class 1
 - Air is drawn through a piping network, a series of filters, and into an optical detector chamber with laser source.
 - The signal is processed and communicated to an alarm center.
 - Ceiling mounted.



Laser Applications – Specific Manufacturing Capabilities

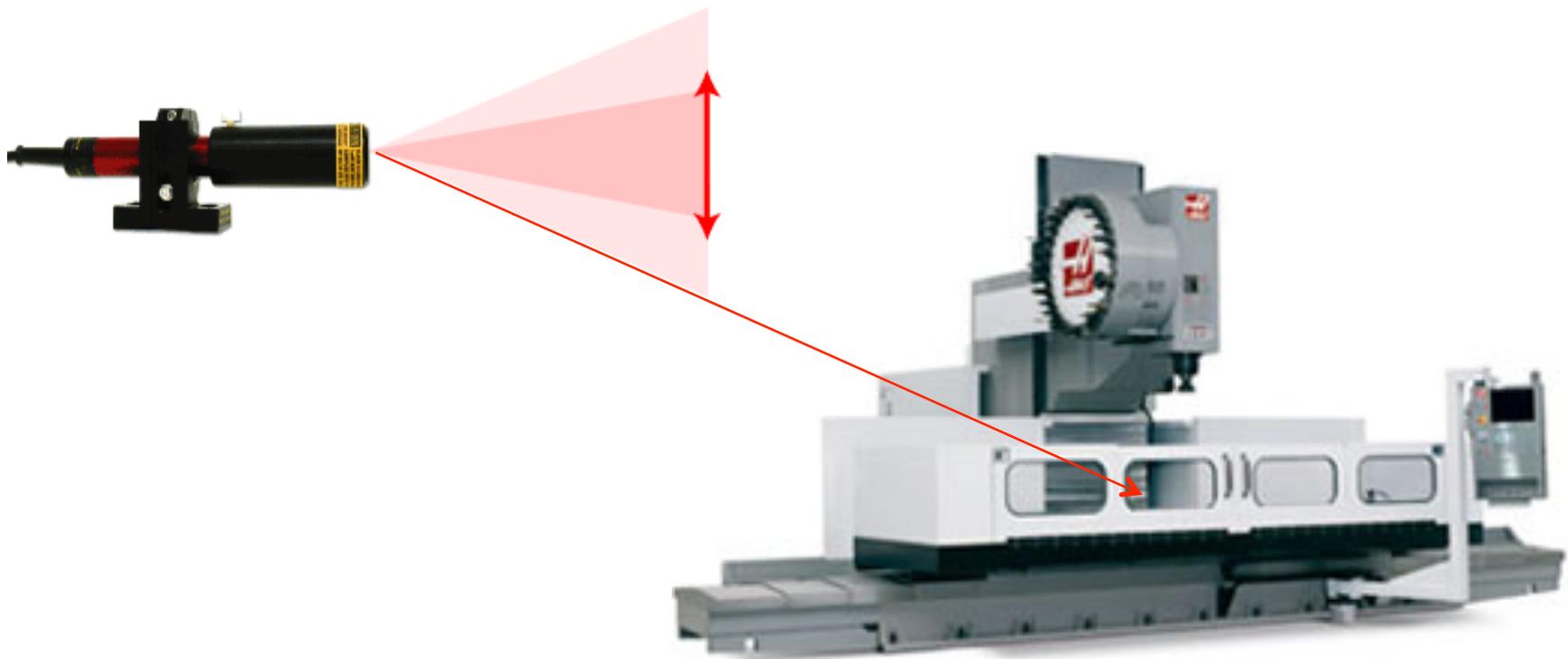
Manufacturing

- ⊕ 2500-4000 Watt, Class 4, CW, CO₂
 - Interlocked gates, light curtains
 - Pressure sensitive mats
 - Dual or remote initialization
 - Qualification checklists
 - Alignment training



Laser Applications – Specific Manufacturing Capabilities

- ⊕ Class 2, 3A, 3B Embedded line lasers
 - Low effective output power
 - Line filters



Laser Applications – Specific Manufacturing Capabilities

Quality Assurance

- Class 2 HAMAR Laser
 - A plumb laser beam which offer the capability of checking and correcting squareness, flatness and straightness
 - A continuously rotating laser plane is square to the plumb beam to within 1 arc second
 - Base is equipped with illuminated, split-prism levels accurate to within 1 arc second
 - Operational range of 100' radius
 - Machine or tripod mountable
 - May also produce a vertical scan plane
 - Equipment-specific training



Laser Applications-Construction

- Levels, and leveling equipment
- Range finders
- Survey equipment
- Bench top welding
- Laser tape measures



Laser Applications – Materials & Fuels Complex

Engraving

- Embedded class 4
- Interlocked access panels/lid



- A NETZSCH Laser Flash Analyzer (LFA)
 - Class 4 embedded laser
 - Measures thermal diffusivity of non-radioactive samples
 - Remote operation, glove box
 - Fully interlocked



Laser Applications – Materials & Fuels Complex

Hot cells

- Scanning Thermal Diffusivity Microscope (STDM),
 - uses two lasers (Class 3B and Class 4) to measure the thermal diffusivity of samples that are radioactive. It is custom built from off the shelf parts.
 - Remote operation, hot cell
 - Administrative controls



- Gas Sampling/Welding (no photo)
 - Embedded Class 4 laser is used to pierce a container for sampling and seal weld the hole.
 - Remote operation, hot cell
 - Administrative controls

Laser Applications – Central Facilities Area



- High Temperature Test Laboratory
 - Class 4 Pulsed Nd:YAG
 - Viewing port
 - Interlocked doors
 - LCA
 - Visible indicator light
 - Fully enclosed

- Standards & Calibration Laboratory
 - HeNe, Class 3B
 - Calibration of velometers
 - Locked doors, limited access
 - Beam stop
 - Fixed installation



Questions

